Ref. Ares(2020)1489429 - 11/03/2020

Contract No. H2020 – 730617

Development of Functional Requirements for Sustainable and Attractive European Rail Freight

D2.6 – Installed processes to release and execute new condition based and predictive maintenance program

Due date of deliverable: 31/08/2018

Actual submission date: 07/11/2018

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Reviewed: Yes

Type of the deliverable: Report

Document status		
Revision	Date	Description
1	24/10/2018	First issue to WP 2 stakeholders
2	02/11/2018	Comments from WP 2 stakeholders included
3	02/11/2018	Second issue to TMT members
4	07/11/2018	Final version after TMT approval

Project funded from the European Union's Horizon 2020 research and innovation programme

Dissemination Level		
PU	Public	x
CO	Confidential, restricted under conditions set out in Model Grant Agreement	
CI	Classified, information as referred to in Commission Decision 2001/844/EC	

Start date of project: 01/09/2016 Duration: 36 months

EXECUTIVE SUMMARY

The apply condition based and predictive maintenance program is an essential and fundamental process step in the communication, distribution and training of the modified maintenance program to ensuring a consistent application. For this reason, the DB CARGO Service Centres, ECM 2, ECM 3 and ECM 4 are involved at an early stage in the development and validation of the condition based and predictive maintenance program to ensure a smooth and complete knowledge migration. The underlying factor is that without a stringent and consistent application and compliance of the defined condition and predictive maintenance strategy, the determined lifecycle cost savings and the increased technical availability can’t be realized in the planned time period.

A distribution, migration and approval process will be installed to support the distribution and migration of the new maintenance program. The target is to ensure that all maintenance shops are promptly instructed and compliant with the new condition based and predictive maintenance program.

ABBREVIATIONS AND ACRONYMS

n/a

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1. INTRODUCTION

Today's existing maintenance intervals (periods and revision) will be dissolved due to the condition based and predictive maintenance concept, and every single maintenance measure will be associated to a component and divided into individual tasks packages (system based). Thus, it is possible that any necessary maintenance measures can be scheduled in separate downtimes, which have a much smaller effect on the operation. As a result, the technical availability of the locomotives will be significantly affected in a positive way.
The system-based bundling of maintenance measures is carried out based on various maintenance criteria such as:

(1) location of the locomotive and maintenance shop,
(2) material (spare parts, operating material) availability,
(3) existing infrastructure of the workshop,
(4) required tools,
(5) technical qualification and
(6) the technical sequence of measures (e.g. the installation location, etc.).

Due to the high number of locomotives, the complexity and the dependency of the algorithm within the bundling will be calculated automatically.

To install such a system, it is heavily important to have an common understanding between all involved stakeholders how to develop such monitoring algorithms' and a process level. To enable an asset management organization, it is necessary to have a coordinated and aligned process to develop and release new maintenance programs between the different roles. In addition, it is heavily important and mandatory to a have joint view on how develop a condition-based and predictive maintenance program. We therefore developed with all involved parties and stakeholders a common state of the art and interdisciplinary functional process on how to combine data driven maintenance with the traditional maintenance schedule change approach. With the aim of ensuring that all necessary findings are adequately documented.

2. INSTALLED PROCESSES TO RELEASE AND EXECUTE NEW CONDITION BASED AND PREDICTIVE MAINTENANCE PROGRAM

In order to be able to install and apply a fundamentally different maintenance strategy it is essential not only focusing on technical (loco engineering) feasibility and IT feasibility it is also required to adapt and further develop the existing process landscape (e.g. how does asset managers work in the future?). It is heavily important to have a holistic few when adapting a condition-based and predictive maintenance strategy. By implementing a condition based and predictive maintenance concept, we focused on the process step itself and the relevant tools which will be used to conduct each process step. As always “one size does not fit all” meaning we will have several technologies in place to turn the prevailing maintenance strategy of individual components into a condition-based maintenance approach. Our process is a blueprint to guide the CBM Transformation Managers through the complex way of changing maintenance rules and give guidance and advice on how to involve different stakeholders or in which step which stakeholder is important and required to support (or release maintenance schedules). We therefore defined process steps and aligned each process step to a technology or tool (could be Jira, data analytics tools or office tools etc.) to help by finding the right technology.

Our generic process describes and answers the question on how to best implement condition-based maintenance. We see that a lot of companies are working in the area of data analytics or optimizing maintenance rules, but no one has a full end-to-end approach on how to start with ideas or hypothesis, component and data selection, data analytics by using for example artificial intelligence or machine learning techniques, turn these outcomes in concrete fields of action and apply these actions on a daily basis at a fleet manager level or maintenance shop. In addition, we experienced that several domains and subject matter experts needs to work in a joint approach – it is not sufficient to only focus on loco engineering or data analytics. It is heavily important to combine data analytics, loco engineering, ECM 2, and IT know-how. Our process describes how these domains will jointly work together to reach the same goal.

Our developed process is in important pre-condition for the deliverable D8 (Modified IT system with all required parameters to compare actual values and thresholds and to deduct maintenance tasks). With the help of this process each involved stakeholder knows at which state he is required and how the content of the modified IT system will be developed, and the information flow is managed. In addition, this process ensures that the result is quality assured and compliant to ECM regulations.

The “Installed processes to release and execute new condition based and predictive maintenance program” includes five different roles that interact to develop, refine and evaluate monitoring messages which occurs due to reaching thresholds based on the actual condition and usage of a locomotive

Item No.1: In a first step, the Data Scientist, the CBM Engineer and the ECM2 each develops ideas how to monitor components and critical locomotive behavior and document them in Excel. Each of these roles selects a component and then defines a Use Case on Confluence. The Data Scientist is an exception: He gets additional locomotive data based on telematic data and ERP data such as cost structure, repair reports etc. as input to define the use case on Confluence. Using the use cases defined in the previous step, the CBM engineer then evaluates the effects in Excel. If the economic efficiency is confirmed by the CBM engineer, he defines thresholds and necessary telematic signals.

Currently there are more than 6.000 signals available on the MVB but not all of them are relevant to assess the condition of a locomotive. Therefore, it needs to be wisely evaluated which signal(s) is/are relevant for which component or which use case or which combination of signals can be valuable in order to keep the data transfer to the landsite economical viable. If the long-term economic efficiency is not confirmed, the CBM engineer redefines the scope of the use case. The process then takes the same path as described above.

Item No.2: After the economic efficiency has been confirmed and the necessary signals have been defined, the CBM engineer next defines the sampling (e.g. do we need the data every second?) and transfer rate (how often do we need to calculate the data?). The telematic box then transmits the signals to the land side. If the signals cannot be transmitted, further data must be connected and/or traction units must be equipped with additional sensors (e.g. running gear sensors). In this case, the process ends with these two measures.

If the signals are transmittable, they are provided by the AIC for the Data Scientist. The data scientist performs a "proof of concept" using "Matlab, R or Python" and/or "Splunk" to programming the rule engine. If the feasibility is not confirmed, the process begins anew by the Data Scientist developing and documenting ideas (see beginning) **(see Item No. 3).**

Item No.4: If the Data Scientist confirms the feasibility after he has carried out a "Proof of Concept", the CBM engineer prioritizes the implementation with the help of Jira and/or a core team meeting. The CBM engineer then defines an implementation concept. If maintenance regime changes are necessary in this implementation concept, an IW-C maintenance regime change process is initiated by the ECM 2. If no maintenance regime changes are necessary, the CBM engineer tests the prototypes using Splunk and SAP-ISI. In the next step, the CBM engineer validates a solution. He receives input from two different sources: On the one hand from analyses within the process (Hotline, Maintenance Department, Fleet Management) from the CM Dashboard and on the other hand from the data of the findings and the actual work of the maintenance department from SAP. Once this step has been taken and a solution has been validated, ECM 2 will adapt Splunk and/or SAP. In a final step, the monitoring message is implemented by the CBM engineer.

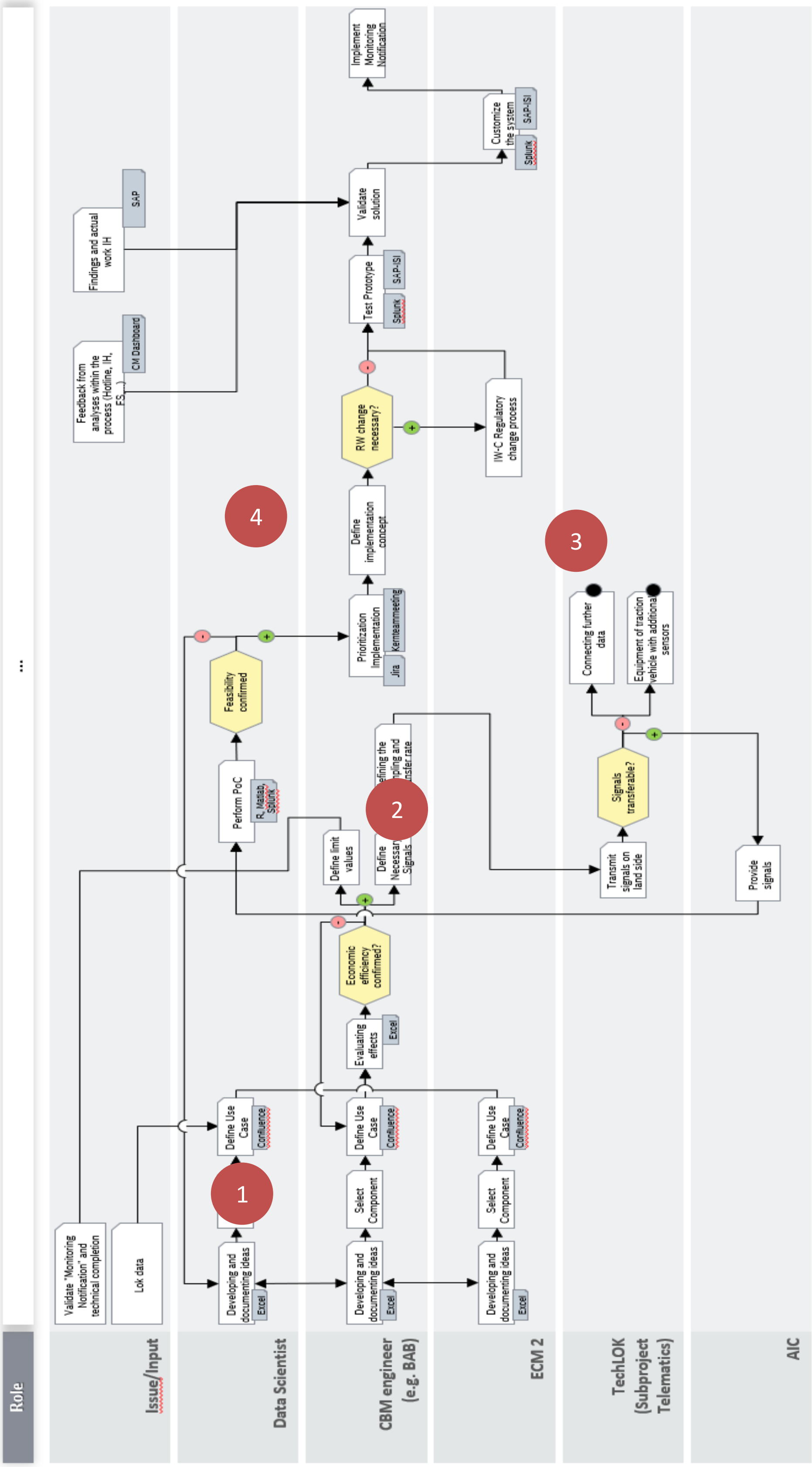

Figure 1: Installed processes to release and execute new condition based and predictive maintenance program

REFERENCES

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